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Amendment under 37 CFR 1.116 Expedited Procedure

Examining Group 2664

PATENT

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-6. (Canceled)

1 7. (Currently amended) ~~The system of claim 5~~ A system for managing
2 multiple links in a label switched network, comprising:
3 a plurality of wide band virtual links including a plurality of input virtual links
4 and a plurality of output virtual links, each such virtual link including a plurality of physical
5 links;
6 a plurality of ingress nodes, each ingress node configured to receive packets and
7 label the packets with associated labels;
8 a plurality of label switching nodes, each label switching node configured to
9 receive the labeled packets having respective associated labels via input virtual links and forward
10 the received labeled packets based on their respective associated labels via output virtual links,
11 each label switching node further including a control component configured to maintain label
12 information relating to the associated labels and a forwarding component configured to perform
13 forwarding of the received labeled packets based on the label information; and
14 a plurality of egress nodes, each egress node configured to receive the labeled
15 packets forwarded from one of the plurality of label switching nodes,
16 wherein label switching nodes are identified as belonging to a label switched path
17 and virtual links interconnect the identified label switching nodes belonging to the label switched
18 path;
19 wherein the physical links within each of the virtual links used to interconnect the
20 identified label switching nodes are collectively regarded as a single entity by the control
21 component with respect to the label switched path;

22 wherein each associated label belongs to one of a plurality of classes;
23 wherein the associated labels are used by a label switching node to forward
24 packets belonging to a corresponding class onto one of the plurality of physical links of an output
25 virtual link; and

26 wherein a first hash function operates on an associated label of a packet to be
27 forwarded via an output virtual link to thereby obtain a hash value, the hash value representing a
28 physical link within the output virtual link used to forward the packet.

1 8. (Previously presented) The system of claim 7 wherein by using the first
2 hash function on the associated label of the packet, the packet is capable of being forwarded to a
3 physical link within the output virtual link without changing its associated label.

1 9. (Previously presented) ~~The system of claim 5~~ A system for managing
2 multiple links in a label switched network, comprising:
3 a plurality of wide band virtual links including a plurality of input virtual links
4 and a plurality of output virtual links, each such virtual link including a plurality of physical
5 links;

6 a plurality of ingress nodes, each ingress node configured to receive packets and
7 label the packets with associated labels;

8 a plurality of label switching nodes, each label switching node configured to
9 receive the labeled packets having respective associated labels via input virtual links and forward
10 the received labeled packets based on their respective associated labels via output virtual links,
11 each label switching node further including a control component configured to maintain label
12 information relating to the associated labels and a forwarding component configured to perform
13 forwarding of the received labeled packets based on the label information; and

14 a plurality of egress nodes, each egress node configured to receive the labeled
15 packets forwarded from one of the plurality of label switching nodes.

16 wherein label switching nodes are identified as belonging to a label switched path
17 and virtual links interconnect the identified label switching nodes belonging to the label switched
18 path;

19 wherein the physical links within each of the virtual links used to interconnect the
20 identified label switching nodes are collectively regarded as a single entity by the control
21 component with respect to the label switched path;

22 wherein each associated label belongs to one of a plurality of classes;
23 wherein the associated labels are used by a label switching node to forward
24 packets belonging to a corresponding class onto one of the plurality of physical links of an output
25 virtual link;

26 wherein one of a plurality of hash functions is used to operate on respective
27 associated labels of packets to be forwarded via an output virtual link to obtain corresponding
28 hash values;

29 wherein the respective associated labels correspond to at least one class; and
30 wherein the corresponding hash values represent physical links within the output
31 virtual link that are to be used to respectively forward the packets.

1 10. (Previously presented) The system of claim 9 wherein by using one of the
2 plurality of hash functions to operate on the respective labels, the packets associated with the
3 respective associated labels are apportioned among the physical links within the output virtual
4 link.

1 11. (Previously presented) The system of claim 9 wherein the hash function
2 used to operate on the respective associated labels depends on at least one load balancing
3 condition.

1 12. (Original) The system of claim 7 further comprising:
2 a plurality of label forwarding tables, each label forwarding table having a
3 plurality of entries, each entry including an input virtual port number, an input label, an output
4 label and an output virtual port number; and
5 wherein the input virtual port number represents identification information
6 relating to an input virtual link through which an input packet is received, the input label
7 represents label information relating to the input packet, the output label represents label
8 information relating to an output packet and the output virtual port number represents
9 identification information relating to an output virtual link through which the output packet is to
10 be forwarded.

1 13. (Previously presented) The system of claim 12 wherein each label
2 forwarding table is associated with a physical link within an input virtual link.

1 14. (Previously presented) The system of claim 12 wherein a first label
2 switching node forwards a packet to a second label switching node via a physical link within a
3 virtual link coupling the first label switching node and the second label switching node;
4 wherein the first label switching node uses the first hash function to operate on the
5 associated label of the forwarded packet to obtain its corresponding hash value, the
6 corresponding hash value representing the physical link within the virtual link;
7 wherein for a label forwarding table associated with the physical link within the
8 virtual link at the second label switching node, an entry is tagged if a hash value of the input
9 label for that entry is equal to an input practical port number which corresponds to the physical
10 link within the virtual link;
11 wherein the second label switching node uses a second hash function to obtain the
12 hash value of the input label for that entry;
13 wherein the first hash function and the second hash function are synchronized.

1 15. (Previously presented) The system of claim 14 wherein the label
2 forwarding table associated with the physical link within the virtual link at the second label
3 switching node is modified to include only tagged entries.

1 16. (Previously presented) The system of claim 14 wherein when a packet is
2 received via the physical link within the virtual link at the second label switching node, only the
3 tagged entries within the label forwarding table associated with the physical link within the
4 virtual link at the second label switching node are searched for an entry corresponding to the
5 received packet.

1 17. (Previously presented) A system for setting label switched paths in a label
2 switched network, comprising:

3 a plurality of wide band virtual links; and

4 a plurality of nodes interconnected to each other via the plurality of virtual links;

5 and

6 wherein a label switched path is identified for transmitting packets through the
7 label switched network and the path includes virtual links and nodes; and

8 wherein each node in the label switched path further includes control logic
9 configured to select a hash function to operate on respective labels of received packets to obtain
10 corresponding hash values, and the corresponding hash values represent physical links within the
11 virtual link that are to be used to forward the received packets.

1 18. (Previously presented) The system of claim 17 wherein each node in the
2 label switched path is configured to receive packets having respective labels via links connected
3 thereto and forward the received packets based on their respective labels via links connected
4 thereto;

5 wherein each node in the label switched path includes a control component
6 configured to maintain label information relating to the labels and a forwarding component
7 configured to perform forwarding of the received packets based on the label information; and

8 wherein for a node in the label switched path, if the link to be used to forward a
9 received packet is a virtual link, the received packet is capable of being forwarded to any of the
10 physical links within the virtual link without changing its label that is established in an initial
11 signaling process.

1 19. (Previously presented) The system of claim 17 wherein the label
2 associated with a packet comprises at least one of a single sequence of bits of fixed length and
3 wavelength of optical carrier.

 20. (Canceled)

1 21. (Original) The system of claim 18 wherein the node in the label switched
2 path further comprises:

3 a plurality of label forwarding tables, each label forwarding table having a
4 plurality of entries, each entry including an input virtual port number, an input label, an output
5 label and an output virtual port number; and

6 wherein the input virtual port number represents identification information
7 relating to a virtual link used to receive the packets, the input label represents label information
8 relating to a received packet, the output label represents label information relating to the received
9 packet to be forwarded and the output virtual port number represents identification information
10 relating to a virtual link used to forward the received packet.

 22-24. (Canceled)

1 25. (Currently amended) The label switching router of claim 22-A label
2 switching router for use in a multiple protocol label switched network, comprising:

3 a plurality of wide band virtual links including a plurality of input virtual links
4 and a plurality of output virtual links, each virtual link including a plurality of physical links;

5 a control component configured to maintain label information relating to labels
6 carried by packets received via the input virtual links;

7 a forwarding component configured to perform forwarding of the received
8 packets based on the label information via the output virtual links; and
9 at least one label forwarding table for storing the label information, the at least
10 one label forwarding table having a plurality of entries, each entry having an input virtual port
11 number, an input label, an output label and an output virtual port number;
12 wherein the label switching router is identified as part of a label switched path for
13 routing packets; and
14 wherein with respect to the label switched path, the control component is capable
15 of treating the plurality of physical links within each virtual link as a single entity,
16 wherein a received packet has an associated input label, the associated input label
17 corresponding to a forwarding equivalence class and an associated output label;
18 wherein the label switching router uses the associated input label and an input
19 virtual port number associated with the received packet as keys to look up in the at least one
20 label forwarding table the associated output label and an output virtual port number
21 corresponding to an output virtual link through which the received packet is to be forwarded; and
22 wherein a first hash function operates on the associated output label to obtain a
23 hash value, the hash value representing an output practical port number corresponding to one of
24 the plurality of physical links within the output virtual link through which the received packet is
25 to be forwarded.

1 26. (Previously presented) The label switching router of claim 25 wherein a
2 second hash function is alternately operates on the associated output label to obtain a second
3 hash value, the second hash value representing a second one of the plurality of physical links
4 within the output virtual link through which the received packet is to be forwarded; and
5 wherein by alternately using the first and second hash functions, different ones of
6 the plurality of physical links within the output virtual link are capable of being selected without
7 changing the associated output label.

1 27. (Previously presented) The label switching router of claim 26 wherein by
2 alternately using the first and second hash functions, load balancing for physical links within the
3 output virtual link is achieved.

1 28. (Original) The label switching router of claim 25 wherein for each entry
2 in the at least one label forwarding table, if a hash value of the input label associated with that
3 entry is equal to a predetermined input practical port number, that entry is tagged;

4 wherein the hash value of the input label associated with that entry is obtained by
5 using a second hash function; and

6 wherein the first and second hash functions are synchronized.

1 29. (Previously presented) The label switching router of claim 28 wherein all
2 the tagged entries are copied and stored into an additional label forwarding table; and

3 wherein the additional label forwarding table is associated with the predetermined
4 input practical port number corresponding to an physical link within an input virtual link.

1 30. (Previously presented) The label switching router of claim 28 wherein
2 when a packet is received via an physical link within an input virtual link having the
3 predetermined input practical port number, only tagged entries are searched with respect to the
4 received packet.

31-34. (Canceled)

1 35. (Currently amended) ~~The method of claim 33 further comprising, A~~
2 method for managing virtual links in a label switched network, comprising:

3 grouping a plurality of physical links into a plurality of wide band virtual links,
4 each virtual link having at least two physical links, and the plurality of virtual links including a
5 plurality of input virtual links and a plurality of output virtual links;

6 maintaining a plurality of ingress routers, wherein each ingress router is
7 configured to receive packets and label the packets with associated labels;

8 maintaining a plurality of label switching routers within the label switched
9 network, wherein each label switching router is configured to receive the labeled packets having
10 respective labels from one of the plurality of ingress routers via input virtual links and forward
11 the received labeled packets via output virtual links, each label switching router further including
12 a control component configured to maintain label information relating to the labels and a
13 forwarding component configured to perform forwarding of the received labeled packets based
14 on the label information;

15 maintaining a plurality of egress routers, wherein each egress router is configured
16 to receive the labeled packets forwarded by one of the plurality of label switching routers;

17 establishing a label switched path having at least one label switching router for
18 routing the labeled packets, wherein virtual links are used to interconnect the label switching
19 routers along the label switched path and the label switching routers along the label switched
20 path communicate with one another via their respective control components to exchange label
21 information to establish the label switched path;

22 treating the physical links within each of the virtual links being used to
23 interconnect the label switching routers along the label switched path collectively as a single
24 entity with respect to the label switched path, wherein the exchanged label information does not
25 include identification of which physical links within a virtual link are to be used to forward
26 packets;

27 maintaining a label forwarding table at each label switching router;
28 wherein the label forwarding table includes a plurality of entries, each entry
29 including an input virtual port number, an input label, an output label and an output virtual port
30 number;

31 wherein each of the labels corresponds to a class; and

32 for a packet received via an input virtual link:

33 using an input virtual port number corresponding to the input virtual link
34 and the label of the received packet to look up an output label and an output virtual port
35 number for the received packet in the label forwarding table, the output virtual port

number corresponding to an output virtual link through which the received packet is to be forwarded; and

using a first hash function to operate on the output label for the received packet to obtain a hash value, the hash value representing an output practical port number corresponding to physical link within the output virtual link through which the received packet is to be forwarded.

36. (Previously presented) The method of claim 35 wherein by using the first hash function to operate on the output label for the received packet, the received packet is capable of being forwarded to one of the physical links within the output virtual link through which the received packet is to be forwarded, without changing the output label.

37. (Previously presented) The method of claim 35 further comprising, for the packet received via the input virtual link:

selecting one of a plurality of hash functions to operate on the output label for the received packet to obtain a hash value, the hash value representing an output practical port number corresponding to a physical link within the output virtual link through which the received packet is to be forwarded;

wherein by having the plurality of hash functions, load balancing among the physical links within the output virtual link through which the received packet is to be forwarded is achieved.

38. (Original) The method of claim 35 further comprising:
for each entry in the label forwarding table, tagging that entry if a hash value of the input label associated with that entry is equal to a predetermined input practical port number;
wherein the hash value of the input label associated with that entry is obtained by using a second hash function; and
wherein the first and second hash functions are synchronized.

1 39. (Previously presented) The method of claim 38 further comprising:
2 copying all the tagged entries in the label forwarding table into an additional label
3 forwarding table; and
4 associating the additional label forwarding table with the predetermined input
5 practical port number corresponding to a physical link within an input virtual link.

1 40. (Previously presented) The method of claim 38 further comprising when a
2 packet is received via a physical link within an input virtual link having the predetermined input
3 practical port number, searching only the tagged entries with respect to the received packet.

41. (Canceled)

1 42. (Previously presented) A system for setting label switched paths in a label
2 switched network, comprising:

3 a plurality of links; and
4 a plurality of nodes interconnected to each other via the plurality of links;
5 wherein a label switched path is identified for transmitting packets through the
6 label switched network and includes at least one virtual link which includes at least one physical
7 link interconnecting at least two nodes;

8 wherein each node in the label switched path is configured to receive packets
9 having respective labels via links connected thereto and to forward the received packets based on
10 their respective labels via the links connected thereto;

11 wherein each node in the label switched path includes a control component
12 configured to maintain label information relating to the labels and a forwarding component
13 configured to perform forwarding of the received packets based on the label information; and

14 wherein for a node in the label switched path, if the link to be used to forward a
15 received packet is a virtual link, the received packet is capable of being forwarded to any of the
16 physical links within the virtual link without changing its label;

17 wherein the node in the label switched path further includes control logic
18 configured to select a hash function to operate on respective labels of received packets to obtain
19 corresponding hash values; and
20 wherein the corresponding hash values represent physical links within the virtual
21 link that are to be used to forward the received packets.

43. (Canceled)